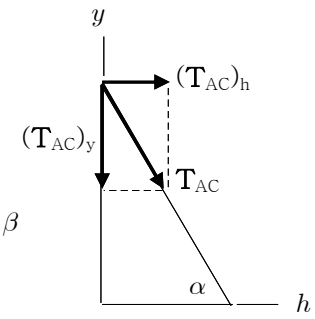
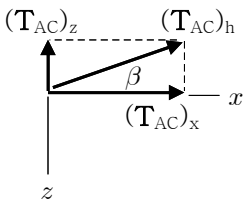
[2.12~14절]

2.77 [공간에서 힘의 직각성분]

T_{AC} = 120 N, α = 60°, β = 20°





(a) $(T_{AC})_y = -T_{AC}\sin\alpha = -(120\text{ N})\sin 60°$

$= -103.92$ N

$(T_{AC})_h = T_{AC}\cos\alpha$

$(T_{AC})_x = (T_{AC})_h\cos\beta = T_{AC}\cos\alpha\cos\beta$

$= (120\text{ N})\cos 60°\cos 20°$

$= 56.38$ N

$(T_{AC})_z = -(T_{AC})_h\sin\beta = -T_{AC}\cos\alpha\cos\beta$

$= -(120\text{ N})\cos 60°\sin 20° = -20.52$ N

⇒ $(\mathbf{T}_{AC})_x = 56.4\text{ N}\,\mathbf{i}$, $(\mathbf{T}_{AC})_y = -103.9\text{ N}\,\mathbf{j}$, $(\mathbf{T}_{AC})_z = -20.5\text{ N}\,\mathbf{k}$

(b) $\cos\theta_x = \dfrac{(T_{AC})_x}{T_{AC}} = \dfrac{56.38\text{ N}}{120\text{ N}} = 0.4698$ ⇒ $\theta_x = \cos^{-1}(0.4698) = 62.0°$

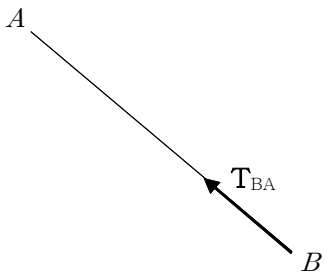
$\cos\theta_y = \dfrac{(T_{AC})_y}{T_{AC}} = \dfrac{-103.92\text{ N}}{120\text{ N}} = -0.8660$ ⇒ $\theta_x = \cos^{-1}(-0.8660) = 150.0°$

$\cos\theta_z = \dfrac{(T_{AC})_z}{T_{AC}} = \dfrac{-20.52\text{ N}}{120\text{ N}} = -0.1710$ ⇒ $\theta_z = \cos^{-1}(-0.1710) = 99.8°$

2.87 [힘의 작용선 상의 두 점과 힘 크기에 의해 정의되는 힘]

T_{BA} = 1,425 N

$d_x = -900$ mm, $d_y = 600$ mm, $d_z = 360$ mm



$d = \sqrt{d_x^2 + d_y^2 + d_z^2}$

$= \sqrt{(-900\text{ mm})^2 + (600\text{ mm})^2 + (360\text{ mm})^2}$

$= 1{,}140$ mm

$\mathbf{T}_{BA} = T_{BA}\,\boldsymbol{\lambda}_{BA}$

$= \dfrac{T_{BA}}{d}(d_x\,\mathbf{i} + d_y\,\mathbf{j} + d_z\,\mathbf{k})$

$= \dfrac{1{,}425\text{ N}}{1{,}140\text{ mm}}[(-900\text{ mm})\,\mathbf{i} + (600\text{ mm})\,\mathbf{j} + (360\text{ mm})\,\mathbf{k}]$

$= (-1{,}125\text{ N})\,\mathbf{i} + (750\text{ N})\,\mathbf{j} + (450\text{ N})\,\mathbf{k}$

⇒ $(\mathbf{T}_{BA})_x = -1{,}125\text{ N}\,\mathbf{i}$, $(\mathbf{T}_{BA})_y = 750\text{ N}\,\mathbf{j}$, $(\mathbf{T}_{BA})_z = 450\text{ N}\,\mathbf{k}$

2.95 [공간에서 힘의 직각성분 합성]

T = 385 N

$(d_{BD})_x$ = −480 mm, $(d_{BD})_y$ = 510 mm, $(d_{BD})_z$ = (280 − 600) mm = −320 mm

$$d_{BD} = \sqrt{(d_{BD})_x^2 + (d_{BD})_y^2 + (d_{BD})_z^2}$$

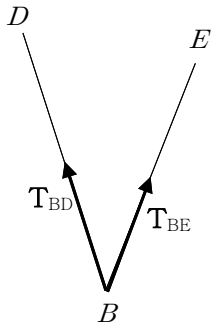
$$= \sqrt{(-480\ \text{mm})^2 + (510\ \text{mm})^2 + (-320\ \text{mm})^2} = 770\ \text{mm}$$

$$\boldsymbol{\lambda}_{BD} = \frac{1}{d_{BD}}[(d_{BD})_x\mathbf{i} + (d_{BD})_y\mathbf{j} + (d_{BD})_z\mathbf{k}]$$

$$= \frac{1}{770}(-480\ \mathbf{i} + 510\ \mathbf{j} - 320\ \mathbf{k})$$

$$\mathbf{T}_{BD} = T\,\boldsymbol{\lambda}_{BD} = (385\ \text{N})\ \frac{1}{77}(-48\ \mathbf{i} + 51\ \mathbf{j} - 32\ \mathbf{k})$$

$$= -240\ \mathbf{i} + 255\ \mathbf{j} - 160\ \mathbf{k}\ \ (\text{N})$$



$(d_{BE})_x$ = (210 − 480) mm = −270 mm, $(d_{BE})_y$ = 400 mm, $(d_{BE})_z$ = −600 mm

$$d_{BE} = \sqrt{(d_{BE})_x^2 + (d_{BE})_y^2 + (d_{BE})_z^2}$$

$$= \sqrt{(-270\ \text{mm})^2 + (400\ \text{mm})^2 + (-600\ \text{mm})^2} = 770\ \text{mm}$$

$$\boldsymbol{\lambda}_{BE} = \frac{1}{d_{BE}}[(d_{BE})_x\mathbf{i} + (d_{BE})_y\mathbf{j} + (d_{BE})_z\mathbf{k}]$$

$$= \frac{1}{770}(-270\ \mathbf{i} + 400\ \mathbf{j} - 600\ \mathbf{k})$$

$$\mathbf{T}_{BE} = T\,\boldsymbol{\lambda}_{BE} = (385\ \text{N})\ \frac{1}{77}(-27\ \mathbf{i} + 40\ \mathbf{j} - 60\ \mathbf{k})$$

$$= -135\ \mathbf{i} + 200\ \mathbf{j} - 300\ \mathbf{k}\ \ (\text{N})$$

$$\mathbf{R} = \mathbf{T}_{BD} + \mathbf{T}_{BE}$$

$$= [-240\ \mathbf{i} + 255\ \mathbf{j} - 160\ \mathbf{k}\ \ (\text{N})] + [-135\ \mathbf{i} + 200\ \mathbf{j} - 300\ \mathbf{k}\ \ (\text{N})]$$

$$= -375\ \text{N}\ \mathbf{i} + 455\ \text{N}\ \mathbf{j} - 460\ \text{N}\ \mathbf{k}$$

$$R = \sqrt{R_x^2 + R_y^2 + R_z^2}$$

$$= \sqrt{(-375\ \text{N})^2 + (455\ \text{N})^2 + (-460\ \text{N})^2} = 747.8\ \text{N} \quad \Rightarrow \quad R = 748\ \text{N}$$

$$\cos\theta_x = \frac{R_x}{R} = \frac{-375\ \text{N}}{747.8\ \text{N}} = -0.5015 \quad \Rightarrow \quad \theta_x = \cos^{-1}(-0.5015) = 120.1°$$

$$\cos\theta_y = \frac{R_y}{R} = \frac{455\ \text{N}}{747.8\ \text{N}} = 0.6084 \quad \Rightarrow \quad \theta_x = \cos^{-1}(-0.8660) = 52.5°$$

$$\cos\theta_z = \frac{R_z}{R} = \frac{-460\ \text{N}}{747.8\ \text{N}} = -0.6151 \quad \Rightarrow \quad \theta_z = \cos^{-1}(-0.6151) = 128.0°$$